

LISTING OF THE CLAIMS

1. (Original) A method of fabricating a semiconductor device having a silicon oxide layer, the method comprising:

supplying a nitrogen source gas to a reaction chamber to create a nitrogen atmosphere in the reaction chamber; and

supplying a silicon source gas and an oxygen source gas to the reaction chamber to deposit a silicon oxide layer on a semiconductor substrate of the semiconductor device.
2. (Withdrawn) The method of claim 1, further comprising forming a conductive material layer on the semiconductor substrate prior to supplying the silicon source gas and the oxygen source gas.
3. (Withdrawn) The method of claim 2, wherein the conductive material layer is selected from the group consisting of gate line patterns, bitline patterns, interconnection line patterns and conductive pad layer patterns.
4. (Withdrawn) The method of claim 2, wherein the conductive material layer includes a metal layer having an exposed portion.

5. (Withdrawn) The method of claim 4, wherein the metal layer is selected from the group consisting of W, Ni, Co, TaN, Ru-Ta, TiN, Ni-Ti, Ti-Al-N, Zr, Hf, Ti, Ta, Mo, MoN, WN, Ta-Pt and Ta-Ti.

6. (Original) The method of claim 1, wherein the nitrogen source gas does not include oxygen.

7. (Original) The method of claim 6, wherein the nitrogen source gas is NH_3 gas.

8. (Original) The method of claim 7, wherein a flow rate of the NH_3 gas is from approximately 50 to approximately 1,000 sccm, a temperature of the NH_3 gas is from approximately 500 to approximately 850 °C, and a pressure of the NH_3 gas is from approximately 0.1 to approximately 300 Torr.

9. (Original) The method of claim 1, wherein the silicon source gas is selected from the group consisting of SiH_4 , Si_2H_6 , dichlorosilane (DCS), trichlorosilane (TCS) and hexachlorodisilane (HCD).

10. (Original) The method of claim 1, wherein the oxygen source gas is selected from the group consisting of N_2O , NO and O_2 .

11. (Original) The method of claim 1, wherein the silicon source gas is supplied prior to supplying the oxygen source gas.
12. (Withdrawn) The method of claim 1, wherein the silicon source gas and the oxygen source gas are supplied at substantially the same time.
13. (Original) The method of claim 1, wherein the supply of the nitrogen source gas is stopped after the supply of the oxygen source gas begins.
14. (Withdrawn) The method of claim 1, wherein the supply of the nitrogen source gas is stopped at substantially the same time as the supply of the oxygen source gas.
15. (Withdrawn) The method of claim 1, wherein the supply of the nitrogen source gas is stopped prior to supplying the silicon source gas and the oxygen source gas.
16. (Original) The method of claim 1, wherein the silicon oxide layer is deposited at a pressure of from approximately 0.01 to approximately 300 Torr, at a temperature of from approximately 500 to approximately 850 °C, a flow rate of the silicon source gas is from approximately 1 to approximately 200 sccm, and a flow rate of the oxygen source gas is from approximately 50 to approximately 1,000 sccm.

17. (Original) The method of claim 1, wherein the silicon oxide layer is deposited by a thermal chemical vapor deposition process.

18. (Original) The method of claim 1, wherein the silicon oxide layer is deposited by plasma enhanced chemical vapor deposition using remote plasma.

19. (Original) The method of claim 1, wherein a silicon nitride layer is formed on the semiconductor substrate prior to the formation of the silicon oxide layer.

20. (Original) A method of fabricating a semiconductor device having dual spacers on gate patterns, the method comprising:

supplying a nitrogen source gas to a reaction chamber to create a nitrogen atmosphere in the reaction chamber;

supplying a silicon source gas and an oxygen source gas to the reaction chamber to deposit a silicon oxide layer on gate patterns located on a semiconductor substrate of the semiconductor device;

forming a silicon nitride layer on the silicon oxide layer; and

etching the silicon nitride layer and the silicon oxide layer to form dual spacers on sidewalls of the gate patterns.

21. (Original) The method of claim 20, wherein the dual spacers are formed by anisotropically etching the silicon nitride layer and the silicon oxide layer.

22. (Original) The method of claim 20, wherein the dual spacers are formed by anisotropically etching the silicon nitride layer and isotropically etching the silicon oxide layer.

23. (Original) The method of claim 20, wherein the gate patterns include at least a metal layer having an exposed portion.

24. (Original) The method of claim 23, wherein the gate patterns are formed in a sequentially stacked structure of a gate insulating layer, a polysilicon layer, a tungsten nitride layer, a tungsten layer, and a gate mask layer.

25. (Original) The method of claim 23, wherein the metal layer is selected from the group consisting of W, Ni, Co, TaN, Ru-Ta, TiN, Ni-Ti, Ti-Al-N, Zr, Hf, Ti, Ta, Mo, MoN, WN, Ta-Pt and Ta-Ti.

26. (Original) The method of claim 20, wherein the nitrogen source gas does not include oxygen.

27. (Original) The method of claim 26, wherein the nitrogen source gas is NH_3 gas.

28. (Original) The method of claim 20, wherein the silicon source gas is selected from the group consisting of SiH_4 , Si_2H_6 , DCS, TCS and HCD.

29. (Original) The method of claim 20, wherein the oxygen source gas is selected from the group consisting of N_2O , NO and O_2 .
30. (Original) The method of claim 20, wherein the silicon source gas is supplied prior to supplying the oxygen source gas.
31. (Original) The method of claim 20, wherein the silicon source gas and the oxygen source gas are supplied at substantially the same time.
32. (Original) The method of claim 20, wherein the supply of the nitrogen source gas is stopped after the supply oxygen source gas begins.
33. (Original) The method of claim 20, wherein the supply of the nitrogen source gas is stopped at substantially the same time as the supply of the oxygen source gas.
34. (Original) The method of claim 20, wherein the supply of the nitrogen source gas is stopped prior to supplying the silicon source gas and the oxygen source gas.
35. (Original) The method of claim 20, wherein the silicon oxide layer is deposited at a pressure of from approximately 0.01 to approximately 300 Torr, at a temperature of from approximately 500 to approximately 850 °C, a flow rate of the silicon source gas is from 1 to approximately 200 sccm, and a flow rate of the oxygen source gas is from approximately 50 to approximately 1,000 sccm.

36. (Original) The method of claim 20, wherein depositing the silicon oxide layer is performed by a thermal chemical vapor deposition process.

37. (Original) The method of claim 20, wherein depositing the silicon oxide layer is performed by a plasma enhanced chemical vapor deposition method using remote plasma.

38. (Original) The method of claim 20, wherein a silicon nitride layer is formed on the silicon substrate prior to the formation of the silicon oxide layer.

39. (Original) The method of claim 1, wherein the nitrogen source gas is resolvable at a low temperature.

40. (Original) The method of claim 1, further comprising:
loading the semiconductor substrate into the reaction chamber.

41. (Original) The method of claim 20, further comprising:
forming the gate patterns on the semiconductor substrate.

42. (Original) The method of claim 41, further comprising:
loading the semiconductor substrate including the gate patterns into the reaction chamber.

43. (Original) A method of forming a silicon oxide layer on a substrate comprising:

maintaining a nitrogen atmosphere in a reaction chamber; and

supplying a silicon source gas and an oxygen source gas to form the silicon oxide layer on the substrate.

44. (Original) The method of claim 43, wherein maintaining the nitrogen atmosphere includes:

supplying a nitrogen source gas to the reaction chamber for a period of time.

45. (Original) The method of claim 44, wherein the nitrogen source gas does not include oxygen.

46. (Original) The method of claim 45, wherein the nitrogen source gas is NH_3 gas.

47. (Original) The method of claim 43, wherein the silicon source gas is selected from the group consisting of SiH_4 , Si_2H_6 , dichlorosilane (DCS), trichlorosilane (TCS) and hexachlorodisilane (HCD).

48. (Original) The method of claim 43, wherein the oxygen source gas is selected from the group consisting of N_2O , NO and O_2 .
49. (Original) The method of claim 43, wherein the silicon source gas is supplied prior to supplying the oxygen source gas.
50. (Withdrawn) The method of claim 43, wherein the silicon source gas and the oxygen source gas are supplied at substantially the same time.
51. (Original) The method of claim 44, wherein the supply of the nitrogen source gas is stopped after the supply of the oxygen source gas begins.
52. (Withdrawn) The method of claim 44, wherein the supply of the nitrogen source gas is stopped at substantially the same time as the supply of the oxygen source gas.
53. (Withdrawn) The method of claim 44, wherein the supply of the nitrogen source gas is stopped prior to supplying the silicon source gas and the oxygen source gas.
54. (Withdrawn) The method of claim 43, further comprising:
forming a conductive material layer on the semiconductor substrate prior to supplying the silicon source gas and the oxygen source gas.

55. (Withdrawn) The method of claim 54, wherein the conductive material layer is selected from the group consisting of gate line patterns, bitline patterns, interconnection line patterns and conductive pad layer patterns.

56. (Withdrawn) The method of claim 55, wherein the conductive material layer includes a metal layer having an exposed portion.

57. (Withdrawn) The method of claim 56, wherein the metal layer is selected from the group consisting of W, Ni, Co, TaN, Ru-Ta, TiN, Ni-Ti, Ti-Al-N, Zr, HF, Ti, Ta, Mo, MoN, WN, Ta-Pt and Ta-Ti.

58. (Original) A method of forming dual spacers on a conductive material layer comprising:

- maintaining a nitrogen atmosphere in a reaction chamber;
- forming a silicon oxide layer on the conductive material layer by supplying a silicon source gas and an oxygen source gas;
- forming a silicon nitride layer on the silicon oxide layer; and
- etching the silicon nitride layer and the silicon oxide layer to form dual spacers on the conductive material.

59. (Original) The method of claim 58, wherein maintaining the nitrogen atmosphere includes:

- supplying a nitrogen source gas to the reaction chamber for a period of time.

60. (Original) The method of claim 58, wherein forming the silicon nitride layer includes:

performing a chemical vapor deposition process.

61. (Original) The method of claim 60, wherein the silicon oxide layer is formed by a thermal chemical vapor deposition process.

62. (Original) The method of claim 60, wherein the silicon oxide layer is formed by a plasma enhanced chemical vapor deposition process using remote plasma.

63. (Original) The method of claim 59, wherein the nitrogen source gas does not include oxygen.

64. (Original) The method of claim 63, wherein the nitrogen source gas is NH_3 gas.

65. (Original) The method of claim 58, wherein the silicon source gas is selected from the group consisting of SiH_4 , Si_2H_6 , dichlorosilane (DCS), trichlorosilane (TCS) and hexachlorodisilane (HCD).

66. (Original) The method of claim 58, wherein the oxygen source gas is selected from the group consisting of N_2O , NO and O_2 .

67. (Original) The method of claim 58, the conductive material layer is selected from the group consisting of a gate line pattern, a bitline pattern, an interconnection line pattern and a conductive pad layer pattern.

68. (Original) The method of claim 67, wherein the conductive material layer includes a metal layer having an exposed portion.

69. (Original) The method of claim 68, wherein the metal layer is selected from the group consisting of W, Ni, Co, TaN, Ru-Ta, TiN, Ni-Ti, Ti-Al-N, Zr, Hf, Ti, Ta, Mo, MoN, WN, Ta-Pt and Ta-Ti.